

## **SECTION 16471**

### **DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS**

#### **PART 1 - GENERAL**

##### **0.1 DESCRIPTION OF WORK**

- A. Work Included: This Section specifies distribution and branch circuit panelboards and panelboard enclosures.
- B. Related Work- Related work should be performed under sections 16050-Basic Methods for Electrical Work, 16450-Grounding, and 08711-Door Hardware

##### **0.2 SUBMITTALS**

- A. Submit for approval catalog cuts, drawings, and data, for each item, indicating the following:
  - 1. Manufacturer's model number or item identification.
  - 2. UL listing and rating.
  - 3. Critical dimensions and mounting arrangements.
  - 4. Complete replacement parts list.
- B. Enclosures: Materials and methods of construction, door arrangement, conduit hub and knockout locations, and identification of intended panelboard.
- C. Circuit Breakers: Circuit for which intended, voltage ratings, insulation level, current rating, and interrupting ratings.
- D. Panelboards: Base material, general arrangement, location and identification of each circuit breaker and the circuit breaker information specified above, location and identification of all terminals, location of barriers, applicable UL 67 Tables A through F information, wiring diagrams, and identification of the enclosure for which intended.

##### **0.3 QUALITY ASSURANCE**

- A. Manufacturing: Manufacturer's and UL standard inspecting and testing procedures.
- B. UL Labels
  - 1. Each factory-assembled enclosure panelboard.

2. Each panelboard shipped separately.
3. Each circuit breaker shipped for field mounting.

C. Listing and Special Marking

1. Each enclosure shipped separate from panelboard shall be UL listed and marked with the identification of the panelboard for which intended.
2. Raintight marking for all enclosures exposed to weather or unusual spray or moisture conditions.

## **PART 2 - PRODUCTS**

### **0.1 GENERAL**

- A. Distribution and branch circuit panels shall be enclosed, completely factory assembled type unless otherwise approved, dead-front grounded enclosure complete with circuit breakers as shown on the Contract Drawings. Design and assemble interiors so that any individual breaker can be replaced without disturbing adjacent units or without removing main bus connectors. Design main buses and back pans of distribution panelboards such that branch circuits may be changed without additional machining, drilling or tapping. Provide cutout type only where specifically indicated.
- B. Materials of construction: UL 67; appropriate NEMA Standards, UL listed.
- C. Field Wiring and Miscellaneous Hardware: Section 16050 - BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK and Section 16450 - GROUNDING, UL listed.
- D. Field Touch-up or Repainting Paint: As recommended by enclosure manufacturer.

### **0.2 CIRCUIT BREAKERS**

- A. In Battery Rooms and Other Hazardous Locations: UL 877, class appropriate to hazard, appropriate rating or as indicated.
- B. Circuit Breakers of the Same Ratings: Interchangeable, quick-make, quick-break.
- C. Circuit Breakers for 125 Volt Battery Power: Rated at 10,000 Amperes interrupting at 250 Volts DC; 2-pole unless otherwise indicated.
- D. Breakers shall have an interrupting rating not less than 10,000 amperes rms symmetrical or as otherwise indicated. The breaker trip element; enclosed compensated for temperature rise and calibrated to 40°C ambient temperature.

- E. Circuit breakers shall be of the indicating type, providing "on", "off", and "tripped" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position between "on" and "off". All multi-pole breakers shall be so designed that an overload on one pole automatically causes all poles to open. The circuit breaker shall be quick-make and quick-break on manual as well as automatic operation and shall have inverse time characteristics secured through the use of a bimetallic tripping element supplemented by a magnetic trip.
- F. The branch circuit breakers shall have fixed thermal-magnetic trips, of values shown on the Contract Drawings, and shall have minimum UL listed interrupting ratings of 10,000 symmetrical amperes at 208Y/120 Volts and 14,000 symmetrical amperes at 480/277 Volts. All breakers shall be bolt-on type.
- G. Provide handle "lock-on" devices on the circuit breakers indicated on the schedules. "Lock-on" devices shall prevent accidental deenergization of critical circuits. These devices shall be trip-free, permitting the circuit breaker to trip automatically on overload. Provide one "lock/on" device for every four circuit breakers indicated in the lighting and power panels. Furnish the Authority for future use all "lock-on" devices not installed.
- H. All circuits, which serve convenience outlets, shall be protected by ground fault circuit breakers for personnel protection.
- I. Main panel circuit breaker must be GFI.

### **0.3 ENCLOSURES**

- A. Panel type with butt hinged door or doors with cylinder housing capable of receiving cylinder specified in Section 08711 - DOOR HARDWARE. Trim must also be hinged.
- B. Mark enclosures for easy identification of intended panelboard unless panelboard is shipped factory installed.
- C. Enclosures for mounting exposed to the weather or in unusually wet locations shall be rainproof type, and so marked. All others shall be standard type.
- D. Directory: Card type, suitable for typewriting directory of circuits, mounted under unbreakable transparent protective cover set in metal frame on inside of door, with provisions for:
  - 1. Panel designation and panel or switchboard from which panel is fed.
  - 2. For each circuit breaker, complete information concerning the circuit controlled, including the voltage and the area, room number, or appliances served; or Main or Spare as applicable.

- E. Finish: Thoroughly cleaned, phosphatized or equivalent, coated with at least one coat of corrosion resisting paint inside and out suitable for the material, and painted with manufacturer's standard electrical grey paint suitable for touch-up or repainting in the field.

#### **0.4 PANELBOARDS**

- A. UL listed and UL labeled unless shipped as a factory-mounted component of a UL labeled enclosed type panelboard with bases not over 48 inches top edge to bottom edge.
- B. Interrupting Devices: Circuit breaker type except where cutouts, meter fuses, or switches are specifically indicated. All cutouts, fuses and pull-out type UL listed.
- C. Panelboards, where shown on the Contract Drawings, shall be equipped with a main protective device consisting of a three-pole switch and current limiting fuses. Ratings shall be as indicated on the panelboard schedules.
- D. Panelboards shall be furnished with an insulated solid neutral bus and a suitable grounding, bus-connected to interior of panel enclosure for termination of green equipment grounding conductor.
- E. Panelboards shall have provisions, including space, terminals, and bus capacity, for future addition of at least one and not less than 10% of the total outlet circuit breakers of each rating. Close extra spaces with spare breakers.
- F. Terminals: Rated solderless type, suitable for either copper or aluminum conductors sized at maximum rated terminal capacity.
- G. Buses and Connecting Straps: Solid copper, main bus rated at the sum of the branch circuit ratings, including motor loads in accordance with Section 430-24 of the National Electrical Code plus 100% of the sum of the trip ratings of the spares specified in paragraphs above, but in no case less than specified in UL 67. Full neutral bus and separate ground bus.
- H. DC Circuits: Completely segregated from ac circuits in UL approved manner, with each DC terminal separated from other DC circuits by UL approved DC type barriers.
- I. Color markings per optional provision UL 67, Paragraph 143.
- J. Marking for easy identification of intended enclosure unless shipped factory mounted in enclosure.
- K. Permanent numerical identification by each breaker space.
- L. Spare breaker spaces closed with spare breaker. Must provide space for 100% spare breakers.

- M. Panelboard cabinets shall have means for securing, supporting, and adjusting the panelboards and trim.
- N. Panelboard gutter space shall be as required by the NEC.
- O. Where gutter spaces are occupied by feeder cables, gutter spaces shall be increased as required.
- P. Panelboard cabinets shall be ordered without knockouts.
- Q. Panelboards shall be furnished with an insulated solid neutral bus and a suitable grounding bus connected to interior of panel enclosure for termination of green equipment grounding conductor.
- R. All panelboard covers and doors must be hinged.

## **0.5 ENCLOSED PANELBOARDS**

- A. Conform to requirements specified in Part 2 "Panelboards" Article.
- B. UL Enclosed Panelboard Label: Form 6, Form 12, or general. Enclosed cutout label only where cutout is specifically indicated.

## **0.6 DISTRIBUTION PANELBOARDS**

- A. Distribution panelboards shall be 480/277 Volt, three phase, four wire, and shall have bolt-in type molded case circuit breakers in the quantities and sizes indicated.

## **0.7 POWER PANELBOARDS**

- A. Power panelboards shall be 120/208 Volt, three phase, four wire, or 480/277 volt, three phase, four wire, and shall have bolt-in type molded case circuit breakers in the quantities and sizes indicated.

## **0.8 LIGHTING PANELBOARDS**

- A. Miscellaneous power and lighting panelboards shall be 208/20 volt, three phase, four wire, and shall have single pole, 277 Volt, bolt-in type molded case circuit breakers in the quantities and sizes indicated.

## **0.9 MISCELLANEOUS POWER AND LIGHTING PANELBOARDS**

- A. Miscellaneous power and lighting panelboards shall be 208/120 Volt, three phase, four wire, or 277 Volt single phase, three wire, and shall have

10,000 Amp interrupting capacity bolt-in molded case circuit breakers in the quantities and sizes indicated.

## **PART 3 - EXECUTION**

### **0.1 GENERAL**

- A. Prior to commencing installation, verify that all surfaces upon or in which enclosures are to be mounted are properly prepared and that all pre-mounting wire pulling has been completed and properly tagged. Take corrective action if necessary.
- B. Verify that enclosure mounting provisions are suitable for intended mounting. Make corrective adjustments, if necessary.
- C. Verify that all factory-installed circuit breakers are correct rating for the applicable circuit application as indicated. Take corrective action if necessary.
- D. Install panelboards in enclosures in accordance with manufacturer's instructions, if practicable before mounting enclosure.
- E. Complete all directory cards with the information indicated in Part 2 "Enclosures" Article above. Typewrite information on directory cards.

### **0.2 ENCLOSURES AND PANELBOARDS**

- A. Install at indicated or approved locations in accordance with manufacturer's instructions, and at convenient operating height such that no manually operable device will be within 2- 1/2 feet of the floor or more than 6-1/2 feet above the floor, and so that the mid-point of all manually operable devices is as nearly as practicable 5-1/2 feet above the floor without exceeding the above maximum height limitations.
- B. Adjust straight and plumb and fasten securely in place. Align and securely and independently fasten each section of multi-section enclosures.

### **0.3 WIRING**

- A. Perform wiring in accordance with Section 16050 - BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK, and UL 67; NFPA 70, Article 240; and manufacturer's instructions.
- B. Perform circuit wiring as specified in Section 16050 - BASIC MATERIALS AND METHODS FOR ELECTRICAL WORK.

- C. Ground as specified in UL 67; NFPA 70, Articles 200 and 250; and Section 16450 - GROUNDING. Connect neutral wire directly to neutral bus, and ground wire to ground bus, in same panel as circuit interrupting device.
- D. Neatly route, harness and support conductors in gutters, wiring spaces and compartments. Bending radii not less than recommended by conductor manufacturer.
- E. Verify that circuits are wired as indicated and are continuous and free of shorts. Energize, as permitted by the Engineer, and test each circuit, including lights and outlets. Check voltage at outlets. Test other electrical equipment as recommended by manufacturer. Measure ground bus and grounded conductor resistance to true ground, resistance between enclosure and ground bus, between pairs of bus bars, and between insulation and ground bus. Resistances shall be within limits specified in Part 3 "Acceptance Tests" Article. If resistances are not within the limits specified, the cause of such resistances shall be determined and corrective action shall be taken to obtain the acceptable resistances specified.
- F. Install bonding jumpers from conduits entering cabinets to ground bus.

#### **0.4 ACCEPTANCE TESTS**

- A. Repeat the tests specified in Part 3 "Wiring" Article in the presence of and to the satisfaction of the Engineer. Test operation of each circuit and circuit control a minimum of 10 times and operation of each circuit continuously for a minimum of 1/2 hour. For all lighting circuits, comply with additional requirements specified in Section 16500 - LIGHTING.
- B. Acceptable Resistances
  - 1. Ground Bus and Grounded Conductor to True Ground: 2 Ohms maximum.
  - 2. Between Enclosure and Ground Bus: less than 0.1 Ohm.
  - 3. Between Pairs of Bus Bars: 50,000 Ohms minimum.
  - 4. Between Insulation and Ground Bus: 10 Megohms minimum.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **0.1 MEASUREMENT**

- A. Distribution and branch circuit panelboards will be measured as per each complete in place, including all preparation, accessories and incidentals.

**0.2 PAYMENT**

- A. Payment for distribution and branch circuit panelboards will be made at the Contract unit price for the quantities as specified above.

**0.3 PAYMENT ITEMS**

ITEM NO.	DESCRIPTION	UNIT
1633.014	PANELBOARDS	EA

**END OF SECTION**